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SCIENTIFIC PUBLICATIONS OF THE GOVERNMENT¹

PUBLICATIONS OF THE U. S. PUBLIC HEALTH SERVICE

By DR. ATHERTON SEIDELL

U. S. PUBLIC HEALTH SERVICE

A GREAT majority of the members of the Washington Academy and its affiliated societies are engaged in research in governmental laboratories. They are the authors of the papers in which by far the larger part of governmental research is described. Although the preparation of these papers is in itself a certain satisfaction, since they are the evidence of worthwhile accomplishments, the real purpose of their publication is to aid others engaged in the advancement of science. This, however, is possible only if the papers find their way to persons engaged in research of a similar kind. This link in the chain of scientific progress is usually given very little attention. Most of us consider that our duty is done when our papers are accepted for

publication. We assume that it is the concern of others to obtain them and not ours to render this task less difficult.

The channels through which papers describing additions to scientific knowledge are most widely distributed are the well-known, regularly appearing, and internationally circulating journals, especially those devoted to specific fields of research. In general, our governmental publications meet these specifications to an exceedingly limited degree. They are usually published irregularly, are of a heterogeneous character, and but a very small proportion of any of them ever get beyond the borders of our country. Descriptions of experimental investigations published in them can thus rarely reach workers in other countries who would be able to use them to advantage.

¹ Papers presented at the January 21, 1943, meeting of the Washington Academy of Sciences.

Fortunately, a large proportion of the scientific papers originating in governmental laboratories are published, with official permission, in journals which insure their distribution to those for whom they were intended. It is only the variable proportion which are reserved for publication in the bulletins, periodicals and serials of the governmental bureaus which largely fail to reach research workers beyond our borders.

An examination of the records of papers originating in the National Institute of Health shows that, of an average of some 434 prepared each year since 1938, only about 125, or less than 30 per cent., were printed in Service publications. Of these, a considerable proportion were of an informational character, hence the number which may be classed as contributions to new knowledge, and thus of particular interest to research workers throughout the world, was relatively small. Their number, however, together with those originating in other governmental institutions is certainly sufficient to justify an examination of the conditions under which they are published and the interests and needs of those to whom they are distributed.

The principal publication of the Public Health Service is the weekly *Public Health Reports*. This contains, (1) statistical information in regard to the prevalence and distribution of communicable diseases, (2) articles relating to the cause, prevention and control of disease, and (3) other pertinent information regarding sanitation and the conservation of public health. It is under the second of these headings that many papers describing the results of highly technical laboratory research are published. The details in these papers are of interest, for the most part, only to workers in similar fields. They are largely wasted upon the great majority of those who receive the publication and who undoubtedly find it helpful for the statistical disease records and informational papers concerning public health administration and amelioration, which it contains.

The mailing list of the *Public Health Reports* is made up principally of persons engaged in public health work. Of a total weekly edition of somewhat more than 7,000 copies, 3,382 go to officers and employees of national, state, and city health departments, 423 go to nurses, and 786 to individuals and institutions. Public libraries receive 860 copies, and medical libraries and universities together receive 561. At present, about 400 copies go to countries other than continental United States and its territories. The distribution in these cases is also largely to health officers and health departments. None, of course, at present, reach the enemy or occupied countries, and a reserve of only 100 copies of each issue is being held to supply the needs of these nations after the war.

The total number of *Public Health Reports* being sent to enemy and occupied countries at the time of our entry into the war was about 200 copies. These were distributed approximately as follows: Germany 32 copies, France 24, Scandinavia 16, Italy 13, Netherlands 10, Russia 6, Belgium 5, Switzerland 4, and all other European countries 36. To China and the Middle East about 40 copies were being sent.

It is estimated that an average of more than 30 strictly scientific papers, making up some 300 pages, or about 15 per cent. of the total contents of the *Public Health Reports* each year, go to a very large number of persons who can have little interest in them, and fail to reach by far the larger proportion of those who would be able to use them for the advancement of science.

In addition to the *Public Health Reports* a series of monographs of a strictly research character are published as *Bulletins* of the National Institute of Health. These are printed in editions of about 2,500 and go largely to libraries, universities and research institutions. The variety of subjects dealt with in these *Bulletins*, their appearance at irregular intervals, and the restricted method of distributing governmental publications beyond our borders, makes it almost impossible for any considerable part of them to reach workers and institutions in other countries. They thus play a very insignificant role as international contributions to the advancement of science.

A publication of our Service, which is very little known, is entitled *Hospital News*. It is published by the planographic method twice a month in an edition of about 1,300 copies and contains brief articles on clinical research, case histories, practices, observations, and reports on improvements in methods and devices. It is a medical periodical of considerable merit, but its circulation, due to administrative limitations, is restricted exclusively to the personnel of the Public Health Service engaged in hospital and relief activities. It is, however, certainly well worthy of a far wider distribution among the medical profession of this and other countries.

Finally, a recent addition to the Public Health Service publications of a purely research character is the *Journal of the Cancer Institute*. This represents the nearest approach so far attained under governmental auspices to the requirements of efficient distribution of scientific papers originating in governmental laboratories. This journal follows the trend of specialization in scientific periodicals in being devoted to a single field of research. It is issued regularly six times per year at a fixed subscription price. Although this journal, like all other government publications, is distributed free to accredited libraries, institutions, and many individuals in the United States,

the Superintendent of Documents has received more than 150 paid subscriptions to it. This case might well be taken as an example of the trend towards which the evolution of governmental publication of

scientific research should proceed. It may be expected that specialized periodicals of this type may eventually provide a self-supporting means of publishing all research originating in governmental laboratories.

THE PUBLICATIONS OF THE NATIONAL BUREAU OF STANDARDS

By J. L. MATHUSA and K. S. GIBSON

A. NUMBER AND CHARACTER OF PUBLICATIONS, INCLUDING JOURNALS, SERIALS AND MISCELLANEOUS

Nine series of publications are issued by the National Bureau of Standards, including the *Journal of Research of the National Bureau of Standards*, Research Papers, Circulars, Handbooks, *Technical News Bulletin*, Commercial Standards, Simplified Practice Recommendations, Building Materials and Structures Reports and Miscellaneous Publications.

1. *Journal of Research, NBS*

The *Journal* is issued monthly and makes available the results of fundamental research (other than confidential work for the Army, Navy and war agencies) in progress in the Bureau's laboratories, including new developments in science and technology.

2. *Research Papers*

These are separate reprints of the articles appearing in the *Journal of Research*. Since the *Journal* covers a variety of subjects, technical groups, research workers and others find it advantageous to obtain the separate papers relating to the subjects in which they are interested. The research papers serve an administrative need in discussing programs of research and in furnishing technical information.

3. *Technical News Bulletin*

This is issued monthly. It contains short articles reporting progress of work, abstracts of articles that appear in the *Journal of Research*, accounts of scientific and technical meetings in which the Bureau staff has participated, and lists of articles by members of the Bureau staff, whether printed in the Bureau's own series or in scientific and technical journals.

4. *Circulars*

The Circulars are compilations of information on various subjects associated with the Bureau's scientific, technical and engineering activities. They include not merely the results of work done at the Bureau, but give information from many other sources. Examples are the National Petroleum Oil Tables; Polarimetry, Saccharimetry, and the Sugars; Static Electricity; Testing Volumetric Glassware; A Test of Lens Resolution for the Photographer. Over 400 of these Circulars have been issued.

5. *Commercial Standards; and 6, Simplified Practice Recommendations*

These are pamphlets issued and revised from time to time as a record of agreements reached with industrial organizations on the qualities, types, and styles of manufactured products. The distinction between the two series is that the Commercial Standards are primarily recommended specifications of quality or performance, whereas the Simplified Practice Recommendations represent voluntary agreements to reduce the number of types and varieties to be given preference in trade practice. Both are developed cooperatively with the industries concerned, through standing committees working with the Bureau on the various projects. During the present emergency the War Production Board and the Office of Price Administration are incorporating the provisions of many of these recommended standards in their mandatory limitation and control requirements, thus conserving strategic materials and manpower.

7. *Handbooks*

These are recommended codes of engineering practice, such as the National Electrical Safety Code, Code for Protection Against Lightning, Protection of Radium During Air Raids, Safety Rules for Electric Fences, Safe Handling of Radioactive Luminous Compounds. They are developed jointly with the industries, engineering standardization groups and national organizations concerned. Over 30 such codes have been issued. In many cases these recommended requirements are given legal status through incorporation in local ordinances by State and municipal regulatory bodies.

8. *Building Materials and Structures Reports*

This series was begun in 1938. It reports the results of work on funds specially appropriated by Congress for the investigation of materials and methods of construction for low-cost housing, including the Government's program of defense housing. The investigations have furnished the Government, the building industry and others concerned information from practically every available source on the engineering properties of materials as incorporated in structural elements and equipment. Recent reports

deal with water-distribution systems for buildings; asphalt-prepared roll roofings and shingles; floor coverings; plumbing; moisture condensation in building walls; water permeability of walls built of masonry units; and a large number of reports on the structural properties of walls, partitions, and floors. Over 90 such reports have been printed.

9. *Miscellaneous Publications*

These are items which do not fit into any other Bureau publication series. In many cases they are charts or other material which has to be of a different size for appropriate printing. Examples are the metric chart, the encyclopedias of specifications, reports of the National Conferences on Weights and Measures and pamphlets more distinctly of an administrative nature.

B. DIVERSITY OF SCIENTIFIC FIELDS COVERED IN EACH

Publications of a scientific, technical and engineering nature emanate from all the scientific and engineering divisions of the Bureau; these cover the fields of electricity, weights and measures, heat and thermometry, optics, chemistry, mechanics and sound, organic and fibrous materials, metallurgy, and clay and silicates. A few of the specialties within these fields relate to electrochemistry, radio and magnetic measurements; length, time and mass; heat measurements, automotive power plants and thermometry; polarimetry, photometry and radioactivity; pH standards, gas and paints; aeronautic instruments and hydraulics; rubber, textiles and plastics; metallurgy of various kinds; and cements and glasses. Over seventy such sections are represented in the organization of the scientific and technical divisions. The Commercial Standardization Group includes the activities on the development and use of specifications, the Commercial Standards and Simplified Practice projects, and the building and engineering code services.

C. SIZE OF EDITIONS AND LIMITATIONS ON DISTRIBUTION

In most cases, the official editions of the Bureau's publications are limited to 1,000 copies. In addition, the Superintendent of Documents prints such copies for sales purposes as the extent of interest in the subject may seem to warrant. The Bureau's distribution of official copies is restricted to the libraries of leading scientific, engineering, and technical organizations, and to educational institutions, where it is expected that they will be available for general reference use. In many cases, the publications are forwarded in exchange for the technical periodicals issued by these organizations. The Superintendent of Documents also distributes free copies of Bureau publications to

the several hundred Government depository libraries throughout the United States. Recent figures show over 1,400 subscriptions to the monthly *Journal of Research and Technical News Bulletin*. Over 40,000 copies of the Handbook on Screw Thread Standards have been sold, and the purchase of the recently issued parts of the National Electrical Safety Code has exceeded 33,000 copies. Sixteen thousand copies of the Simplified Practice Recommendation on Machine Carriage and Lag Bolts have been sold. The current Circulars on Synthetic Rubber and Properties of Dental Materials have had several reprintings.

D. INTERESTS AND ACTIVITIES OF THE INSTITUTIONS AND INDIVIDUALS ON THE MAILING LISTS

As indicated above, the distribution of the Bureau's publications is to public libraries, standardization and technical research groups, leading national research societies and the libraries of other organizations doing research work in physics, chemistry and engineering, or concerned with problems of research and standardization on which the Bureau is engaged. No individual mailing lists are maintained. In many cases cooperative programs of research are in progress, and the Bureau's staff in many instances are members of the society or association engaged in the development of specifications and standards of practice and in the securing of basic research information. Examples are the American Standards Association, American Society for Testing Materials, American Society of Mechanical Engineers, Society of Automotive Engineers, etc. In many cases the research associates representing these organizations are working in the Bureau's laboratories, and their results are printed by the Bureau.

E. PROPORTION SENT OUTSIDE THE UNITED STATES

Because of censorship limitations and procedure, the official distribution of Bureau publications to countries other than Canada has been suspended. The mailing to many European countries was abandoned in 1940. Before the war, the distribution of the *Journal of Research* to foreign countries exceeded 600 copies, many in exchange for foreign scientific and technical periodicals.

F. EXTENT TO WHICH INSTITUTIONS OR PERSONS IN OTHER COUNTRIES CAN OBTAIN OR GAIN ACCESS TO BUREAU PUBLICATIONS

Except for the present limitations indicated in E, the publications of the Bureau have been available in many of the leading foreign libraries. The sale of Bureau publications by the Superintendent of Documents makes them generally available.

THE PUBLICATION OF SCIENTIFIC AND TECHNICAL MATERIAL BY THE UNITED STATES DEPARTMENT OF AGRICULTURE

By Dr. M. C. MERRILL

CHIEF OF PUBLICATIONS, U. S. DEPARTMENT OF AGRICULTURE

THE Department of Agriculture was created by act of Congress May 15, 1862. The act stated that the "general designs and duties" of the Department "shall be to acquire and to diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word." During the 79 years of its life up to the present war the department issued 253 series of publications, including 43 periodicals, all of which are now defunct. The total number of separate publications (not copies) in the numbered series was 10,516. These were issued from 66 bureaus or units, some of which have, of course, passed into the realm of the deceased along with their publications. Most of those series had bureau or division designations and were typical of the bureaus' publication independence to a large degree in the early years. It was not until 1913 that the bureau series were largely consolidated into the department series.

At the outbreak of the second world war the department was issuing 98 series of publications, including 16 periodicals. These were exclusive of the publications prepared in the Bureau of Biological Survey, the Food and Drug Administration, the Bureau of Public Roads, and the Weather Bureau that had been transferred to other agencies.

Thus the passage of time has brought numerous changes in the administrative phases of the department's publication program. Though the form and structure of its technical publications have remained well stabilized through the years, their content has undergone extensive modification. First published in the era when a professor of agriculture was taking his place on college faculties and was a recognized authority in the broad fields of cultivated plants, domesticated animals, and soils, the early agricultural bulletins bore evidence of that generalization. And yet it is surprising what splendid scientific work was done in those days under the conditions prevailing and how well and carefully the results were authenticated so that they became monuments of established validity and finality built to endure a long time. We accordingly appreciate that work and honor the workers who labored as best they could without either knowledge or benefit of the modern methods and materials, technic, equipment, and statistical interpretations so commonplace in present-day publications.

Along with this development in the content of the

scientific publications of the department has come the age of specialization when each scientist in his research work is concentrating on ever-narrowing fields of inquiry. Hence when he publishes the results of studies in his specialty it is natural to expect that the number of professionally interested readers will also become smaller and smaller as the specialty narrows down. One authority in the field of the social sciences recently remarked that the subject matter there has become so specialized that at the scientific meetings held by the general organization he as a specialist in one field has a hard time understanding the specialists in other fields if he happens to stroll into their meeting and listen to some of their papers. The physical, chemical, and biological scientists are also earnestly engaged in building this scientific Tower of Babel.

The series in which the major part of the research and technical material now published by the department is issued are the *Journal of Agricultural Research*, Technical Bulletins, Circulars, Miscellaneous Publications, Statistical Bulletins, and Soil Surveys. For our purpose here let us confine our consideration to only the first three (*Journal of Agricultural Research*, Technical Bulletins, and Circulars). The *Journal of Agricultural Research* publishes only articles carrying original research done in the department and at the State Agricultural Experiment Stations. Usually only one phase of an investigation is covered and each paper therefore may be regarded somewhat as a progress report. Even though the *Journal* does not ordinarily publish papers in economics, sociology, physics, or engineering, but only on subjects related to the botanical, chemical, mycological, cytological, genetic, nutritional, entomological, pathological, physiological, ecological, morphological, anatomical, and taxonomic phases underlying the production of plants and animals from the soil, the variety is wide, as you will appreciate, and each volume contains a mass of scientifically heterogeneous material. Naturally no one scientist is particularly interested in all of it but only in the articles published in his special field. To take account of that circumstance and provide for it, each article in the *Journal* is issued and distributed as a separate. Thus the *Journal* proper has its major usefulness in libraries, departments, or laboratories where several will see it. It is not sent free to individuals.

The Technical Bulletins contain the more compre-

hensive results of investigation. Each publication is accordingly a separate, independent entity with a more or less complete statement of the study and findings in the subject covered. Though the bulletin is in a numbered series its subject may be entirely unrelated to that of the one preceding and of the one following. The Circulars issued by the department are semi-technical in character, some leaning toward the popular and others toward the technical aspects.

It, of course, is one thing to prepare and issue printed matter, but what about its distribution? How many copies are published and where do they go? For a partial answer to these questions let us look into the distribution records for these series.

For free distribution we order nearly 2,000 copies of the *Journal*. In addition to that number the Superintendent of Documents provides as many as are needed for the approximately 546 depository libraries entitled to receive free all material issued by the government. Before this war the *Journal* was going to institutions in 84 foreign countries in exchange for their publications. Many years ago a study both in this country and in Europe by Dr. Karl F. Kellerman, the father of the *Journal*, led him to the conclusion that neither scientific reviewing journals nor libraries paid as much attention to bulletins as to the material published in journals because in the latter it is more accessible by virtue of the volume indexes, a convenience not ordinarily provided in individual bulletins.

The free mailing list for the *Journal* shows that it is being sent to the following:

98	copies to university libraries
179	" college libraries
91	" laboratories
198	" experiment stations
90	" department field offices
43	" other government departments
39	" societies and institutions
59	" state government departments
76	" department bureaus and divisions
58	" public libraries
57	" miscellaneous
777	" countries outside of continental United States

During the war of course the sending of our published material to foreign countries is greatly restricted, but as it comes off the press that which can not be sent now is wrapped and held for mailing after the war.

In addition to the distribution indicated above the originating bureau or experiment station is given 250 copies of the separate of each article it submits.

During the fiscal year 1941 the Superintendent of Documents sold 672 subscriptions to the *Journal* and 18,825 copies of separates; in 1942, he sold 518 subscriptions and 15,876 copies of separates. This decrease was undoubtedly caused by the war. But these figures nevertheless indicate a fairly wide distribution of *Journal* material.

The editions of Technical Bulletins and Circulars for free distribution by the department normally range from 2,500 to 3,500 copies. To these are added the necessary copies for the depository libraries and the sale stock. The mailing list distribution is made to practically the same institutions as given above for the *Journal*. In the last fiscal year we distributed free 593,865 copies of Technical Bulletins and Circulars, and the Superintendent of Documents sold 53,448 copies.

Because of the pressure upon our printing funds from so many angles for the various types of material issued by the department, ranging all the way from the highly scientific and technical to that which is very popular and even of ephemeral interest, it has not been possible, and it is probably not desirable, for the department to publish all of the technical and research papers written by its staff. During the last fiscal year there went through my office 1,974 articles, nearly all of technical nature, for delivery outside the department or publication in outside journals. To provide for the further distribution of 265 of these, about 200 copies of reprints of each were purchased. In comparison with these 1,974 articles delivered or published outside the department, there were sent to the Printing Office for publication by the department only 237 manuscripts, or 12 per cent. as many, for the *Journal*, Technical Bulletin, Circular, Miscellaneous Publication, Statistical Bulletin, and Soil Survey series.

Now whether the publication program of the department is fully fulfilling the measure of its creation and adequately meeting the requirements of the scientists in this country and throughout the world who can make best use of the information is a question to which a great deal of thought has been given. Editorially we have tried to present the information as clearly, concisely, and effectively as possible, and to maintain high standards of publication in the interest of the readers. We have also tried to distribute this information wisely and get it into the hands of those who can use it to best advantage. But no doubt there is room for improvement all along the line and it is accordingly hoped that out of the discussion to-night will come some valuable suggestions for our guidance.

DISCUSSION OF SOME ASPECTS IN THE PUBLICATION OF GOVERNMENT RESEARCH

By RALPH R. SHAW

LIBRARIAN, U. S. DEPARTMENT OF AGRICULTURE

CREATION and dissemination of knowledge are twin processes. Dissemination is the mechanism through which the results of research are made effective over a greater sphere of human endeavor; it makes possible the application of new knowledge to human welfare and to the creation of more or sounder knowledge in the laboratory.

The question of form of publications both primary (in the sense of new contributions to knowledge) and secondary (in the sense of interpretations or organization of knowledge) has received the attention of scientists, publishers, editors and librarians for many years, and yet no complete answer to the many complex problems involved has been discovered.

Bibliography, as an art, was first practiced by scholars whose aim was to combine into one easily digested capsule all the world's knowledge relating to a subject in hand.

Dr. Atherton Seidell's recommendation of the publication of narrowly limited subject periodicals by the Federal Government is, therefore, in the classical tradition, and it looks toward the filling of one of the many lacunae in the dissemination of knowledge. In so far as it groups like knowledge together, it is an aid in the organization of knowledge and in the provision of ready access to more of the results of research.

If it is considered as a substitute for other publications, then this proposal has a number of implications for future research, and implementation of research through publication, that require serious consideration.

The grouping of all the governmental research output into a limited series of subject publications has been under some consideration by official sources as an economy measure. Obviously, the only way to cut printing expenditures, if unit printing costs are kept constant, is to publish less of the results of research, and that measure, although necessary to a certain extent in wartime, is not desirable, and will, I believe, result in waste rather than in economy in the long run.

Even the view that time in searching will be saved by consolidation of those products of governmental research which actually do now appear in government publications into subject journals is open to question, because only a fraction of the federal research output is now published at government expense, and it would still be necessary for specialists to consult the other journals in which federal research in their fields is printed.

If it were attempted to overcome that by printing all the results of federal research in such journals, then printing funds would have to be increased enormously, and even that would not achieve the utopia of one book only for each specialist, because there would still be the necessity for scanning the great mass of publications reporting the research of state agencies, associations, private groups and foreign governments.

All this consideration is, of course, based on the assumption that we have achieved specialization to an extent such that each scientist works exclusively in a narrowly delimited subject field. The interdependence of research in various fields is, in fact, so great that almost no one can afford to neglect developments in related fields.

As a case in point, look at any recent number of any indexing or abstracting journal. In a recent issue of the *Experiment Station Record*, for example, under "Animal Production" you will find: papers read before the American Institute on Nutrition, reports published in the various series issued by the state experiment stations, books, articles in journals issued by various federal agencies, general science journals such as SCIENCE, applied chemistry journals, such as *Industrial and Engineering Chemistry*, foreign governmental research journals, medical veterinary journals and many others, almost all of which treat this one subject from differing points of view.

Looking at this question from still another point of view, it must be noted that most of the government journals are now subject journals. The difference that now exists between such specialized publications as the *Journal of Agricultural Research* (which, as Dr. M. C. Merrill pointed out, is limited to certain segments of the limited field of agriculture) and the still more narrowly limited specialized journals that Dr. Seidell recommends, is merely a matter of degree. In fact, if cancer research develops at the rate that we all hope it will, the *Journal of the Cancer Institute* may itself be a general journal in its field ten or twenty years from now.

Still another factor that might well be considered is the effect of a drastic change in government publishing policy upon the fortunes of association, scientific, trade and technical journals which are an important link in the chain of dissemination and interpretation of scientific knowledge. As noted in Dr. Merrill's paper, these journals assume a very large share of the task of publishing the results of government research. Such

publications as these, if duplicated by federal journals on heredity or on phytopathology or on what you will, would lose not only their generally shaky financial stability, but would also lose one of their main sources of research publications. It seems doubtful that science, the government or society has much to gain from competition with these useful publications. Any plan for federal publication of subject journals, if it is to improve dissemination of knowledge, must be designed to supplement rather than to supplant these valuable self-supporting journals.

A considerable number of papers reporting results of research can not now find space in all the existing channels combined. These contributions are now published only by deposit in libraries, which then make them available in microfilm or photostat copies. This indicates that such subject journals as Dr. Seidell recommends might be added to the channels of publication, where they do not duplicate other existing channels, with very profitable results.

Regardless of the form of organization of publications as physical objects, the key to giving publications power is the organization of the information contained in the articles or books.

There is a wide variety of techniques for this purpose. In addition to general indexes, abstract journals, and the like, there are specialized tools such as the Index-Catalogue of the Surgeon General's Library, or the Plant Science Catalog of the Department Library, the Bibliography of American Economic Entomology, the Bibliography of Agriculture, the Experiment Station Record, the Index-Catalogue of Medical and Veterinary Zoology and our many special subject bibliographies, which attempt to organize knowledge for use.

Effective use of such tools requires that the literature they list be made available to all scientists throughout the world. To this end, the Department Library, with the aid of Mr. Watson Davis, of the American Documentation Institute, and Dr. Atherton Seidell, has developed its microfilm service, which now provides some twelve thousand articles a year to workers at a distance. In one recent month our Bibliofilm Service supplied film copies of more than sixty thousand pages.

The need for better guides to the content of the world's literature is clearly shown by the classic case of Mendel's work, which was lost to science despite the fact that it was actually published, because it was not published in one of the journals in general circulation, and it was not brought out in a generally distributed index.

Existing indexing and abstracting journals in our fields regularly cover only a small fraction of the 11,500 periodical and serial publications regularly received in the Department Library, and we do not receive all the periodicals in our field of work. Thus a very large percentage of knowledge that is created in laboratory and field all over the world is not readily available to those who should have it. Furthermore, there is a considerable amount of duplication among indexes. It seems to me that serious consideration should be given to the problem of organizing the *content of publications* so that all pertinent knowledge, no matter how written, where published or in what language it is printed, may be promptly and readily available to all men working in any scientific endeavor.

I hope that we may work together with scientists, publishing agencies and librarians of other countries to effect this end after the war is won.

OBITUARY

ALBERT LLOYD BARROWS 1883-1942

FOR more than twenty years the National Research Council has been largely the lengthened shadow of Albert Lloyd Barrows, who was its executive secretary. His death makes it possible to say this. He would have denied the statement vigorously. Over many years' association I have never heard him say that *he* had done a particular task. The task was done only when some one else took responsibility, applied a signature, called a meeting or set the terms of a policy. He would have thought that he had failed if his views were put forward by himself. He was engaged in an associative enterprise. It was his self-imposed task to find the institution or the man who would establish a new current or pool of interest

or drive forward with new energy toward an agreed objective.

He had an unlimited faith in that great American institution which we call the huddle: the habit of agreeing, after debate, on a decision that all could sustain. How often we, his associates over many years, have said, "More than any one else, Barrows is the NRC"! Not the least part of him was his devotion to high scientific standards. He was elected to Phi Beta Kappa and Sigma Xi. He had a well-trained and well-informed mind inspired by the ideal of national service and duty.

Thousands will bear witness to-day to these conclusions. He never thought of himself, served himself or spared himself. To the representatives of more than seventy affiliated organizations and to successive

chairmen of the council and of its divisions, he was an indispensable strength. He knew what the scientific men of America could do.

An executive who shares responsibility for an organization is always looking ahead. There is little enough time in which to reflect leisurely upon or take satisfaction in accomplishment that meets with general approval. His day is lived mostly in to-morrow. One remembers the almost superhuman drive which Barrows put into the things that to-morrow had to put forth. This gave his work the relentless quality of time itself. Time, organization, men and officers, with Barrows added in, became one inexorable continuum. A force reached out from his desk to every part of the country and into every institution where creative work was done in science. He would repudiate my words if he could hear them. He thought of himself only as the agent of an idea—how organization and consultation could promote progress in scientific research. I remember how greatly Oscar Firkins's definition of an institution pleased him: "Whenever man finds a useful idea he creates an institution, systematically to remind himself of the idea."

He could scarcely be brought to talk about his family and he did so in a rare and shy way that was endearing. Only once did he seem to speak spontaneously on that theme—when mention was made of his son's part in the present war as a Lieutenant on a submarine in the Pacific. And what a part! To be told when the war becomes history. His enthusiasm reflected perhaps his own disappointment when our armed preparations began that it seemed best to remain at his post rather than resume active military work at fifty-nine, if indeed he were allowed to do so. For thirty years he had trained for it as a Lieutenant Colonel in the Infantry Reserve. (He had been Captain of a Machine Gun Battery in France, 1917-1919, and won the Croix de Guerre by dangerous reconnaissance at Audenarde in the final push in Flanders.) He loved the techniques of modern military tactics and the possibilities of their efficient use under the chain of unified military command.

He was a born organizer for defined purposes. The

purpose was uppermost. He had an essential instinct for loftiness of purpose and was visibly inspired by it. He had an unquenchable public spirit. If paper work occasionally dragged him down, a turn on his motorcycle or a tour of duty in the reserve officers' corps or a new plan of action and new men and forces in the National Research Council would restore him quickly to his natural rate of putting organizational power back of an agreed plan or idea.

It was most fitting that the memorial services held on November 11, 1942, should have consisted largely of the reading of a few of his favorite poems. There was a passion in his work for the Council and in his spirit that only certain emotional forms of poetry could express. Many who knew only his professional drive and his formal manner missed an integrating and profoundly sustaining quality, his capacity for feeling and for the beautiful expression of it. Now that we can appraise the whole of his life we can choose our viaticum with a better sense of appropriateness in a few lines from Kipling's tribute to the devoted teachers of his school:

For their work continueth,
And their work continueth,
Broad and deep continueth,
Great beyond their knowing.

ISAIAH BOWMAN

RECENT DEATHS

DR. WILLIAM ALBERT SETCHELL, professor of botany, emeritus, of the University of California at Berkeley, died on April 5, 1943, in his seventy-ninth year.

DR. MARY JANE RATHBUN, honorary associate in zoology of the U. S. National Museum, died on April 4 at the age of eighty-two years.

DR. GARFIELD POWELL, assistant professor of chemistry at Columbia University and an assistant to the dean of Columbia College, has died. He was forty-nine years old.

THE death on March 30 is announced of William Oscar Walker, for the last twenty-five years professor of chemistry at McMaster University, Canada.

SCIENTIFIC EVENTS

TUFTS COLLEGE CHAPTER OF THE SOCIETY OF THE SIGMA XI

THE Tufts College Chapter of the Society of the Sigma Xi was formally installed by the national officers of the society on April 2. The day's activities began with an academic procession and convocation, attended by the Tufts College faculty and student body as well as by the national officers and delegates from chapters in many other institutions. At the con-

vocation exercises Dr. Leonard Carmichael, president of the college and member of Sigma Xi, gave a brief history of scientific research at the college. Dr. George Baitsell, of Yale University, national secretary; Dr. Harlow Shapley, of Harvard University, national president, and Dr. Edward Ellery, of Union College, past national president, were introduced and presented interesting accounts of the growth and aims of the Society of the Sigma Xi. A luncheon for the

national officers, the visiting delegates and the college members of Sigma Xi followed.

Dr. Shapley and Dr. Baitzell officiated at the formal installation ceremonies, which took place at 3 p.m. in one of the small college chapels. The new charter was accepted in behalf of the Tufts Chapter by President Carmichael, while Dr. Ellery responded for the society. The newly installed chapter elected the following officers:

President, Dr. Basil G. Bibby, dean of the Tufts College Dental School; *Vice-president*, Dr. Katharine F. Billings, instructor in geology; *President-elect*, Dr. Paul Warren, professor of botany; *Treasurer*, Dr. Herman Sweet, assistant professor of biology; *Secretary*, Dr. Nils Y. Wessell, dean of men.

A tea and reception followed at the home of President and Mrs. Carmichael. In the evening a dinner in honor of the national officers was attended by delegates and Tufts Chapter members. A public lecture followed, with Dr. George David Birkhoff delivering an address on "The Mathematical Nature of Modern Physical Theories."

NILS Y. WESSELL,
Secretary

SUMMER SESSION IN APPLIED MATHEMATICS AT BROWN UNIVERSITY

FOR the third summer, Brown University in its program of advanced instruction and research in mechanics, offers instruction and research direction in a twelve-weeks session beginning on June 14. A dozen graduate courses of a variety of grades are offered. These are largely in subjects related to mechanics, such as elasticity, fluid dynamics, theory of flight and partial differential equations; but there is one comprehensive course in mathematics of ultra-high frequencies in radio, which is particularly designed for those who expect to engage in research in that field. The staff in residence consists of Stefan Bergman, Lipman Bers, L. N. Brillouin, Willy Feller, G. E. Hay, Witold Hurewicz, P. W. Ketchum, Willy Prager and J. D. Tamarkin. In addition a dozen lectures each are scheduled for K. O. Friedrichs, R. E. von Mises and S. P. Timoshenko.

This program is supported by the U. S. Government, the Carnegie Corporation and the Rockefeller Foundation; tuition fees are remitted. There is an overwhelming demand from government agencies and industries for men from this school to do research in the mathematics underlying engineering.

Inquiries may be directed to the Dean of the Graduate School, Brown University, Providence, R. I.

THE COLUMBUS MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE two hundred and fifty-fourth meeting of the American Physical Society will be held at the Ohio

State University on April 30 and May 1. The departure from the Eastern seaboard is due to the unavailability of Washington and Baltimore, to the fact that the last meeting was in New York and the next one will be in Pennsylvania, and to the courtesy of the Ohio State University in offering its hospitality for the second time in less than four years. The meeting will be held jointly with the Ohio Section of the society and Section F (Physics) of the Ohio Academy of Science. The first session will begin at 10:30 o'clock on Friday morning. The headquarters hotel will be the Deshler-Wallick.

A lecture by Dr. Peter Debye, chairman of the department of chemistry of Cornell University, on "The Magnetic Approach to the Absolute Zero of Temperature" will be given at 8 o'clock on Thursday evening before the Ohio Chapter of Sigma Xi. Contributed ten-minute papers will be given in two sessions—on Friday morning at 10:30 and on Saturday afternoon at 2:00. An invited paper by K. Lark-Horovitz, head of the department of physics at Purdue University, on "Semi-Conductors: Their Properties and Their Uses" will be given on Friday afternoon at 2:00.

A part of the symposium in honor of Galileo (who died in 1642) and Newton (born in 1642), which was arranged by the American Association for the Advancement of Science for its New York meeting of December last and which was abandoned when that meeting was called off, will be given at the Columbus meeting through the courtesy of Professors Henry Crew and Louis T. More, who have consented to make available papers that were originally to have been read at the New York meeting. These will be presented on Friday afternoon, beginning at 3:30. Dr. Crew will speak on "Galileo, the Pioneer Physicist" and Dr. More will discuss "Newton's Philosophy of Nature."

A symposium on applied infra-red spectroscopy will be held on Saturday morning at 10:00. The speakers and their topics are: R. Bowling Barnes, American Cyanamid Company, "Applied Infra-Red Spectroscopy"; J. R. Downing, du Pont Experimental Station, "Applications of Infra-Red Spectroscopy to Chemical Research"; H. H. Nielsen and Ely E. Bell, of the Ohio State University, "Automatic Recording Vacuum Infra-Red Grating Spectrometer."

The annual dinner will be held at the Deshler-Wallick Hotel at seven o'clock on Friday evening, when Dr. Charles F. Kettering, of the General Motors Corporation, will speak on "Looking Forward through Research." Members and guests are requested to make advance reservations by letter or card addressed to Dean Alpheus W. Smith at the Mendenhall Laboratory of Physics, the Ohio State University, Columbus.

The council of the society will meet on Friday morn-

ing at 10:45. The annual luncheon for members and guests of the Sigma Pi Sigma, held in conjunction with the spring meeting of the society, will be given at 12:15 o'clock on Friday, April 30.

FIRST CHARLES L. MAYER AWARD OF THE NATIONAL SCIENCE FUND

DR. CHARLES B. HUGGINS, professor of surgery at the University of Chicago, has been selected as the recipient of the prize of \$2,000 given by Dr. Charles L. Mayer and administered by the National Science Fund of the National Academy of Sciences. The award was offered for the most outstanding contribution made during 1942 to present-day knowledge of factors affecting the growth of animal cells with particular reference to human cancer, and as a new type of prize for the advancement of fundamental scientific research administered under a new type of philanthropic foundation.

The advisory committee assisting the National Science Fund in selection of the prize winner consisted of Dr. George H. Whipple, dean of the School of Medicine and Dentistry of the University of Rochester, Nobel prize winner in medicine (joint award) in 1934; Dr. R. R. Williams, chemical director of the Bell Telephone Laboratories, discoverer of Vitamin B₁; Dr. Alan Gregg, director for the medical sciences of the Rockefeller Foundation, and Elihu Root, Jr. The committee decided that the 1942 award should go to Dr. Huggins for his studies of the human prostate, with special relation to the cancers taking origin from this gland. Dr. Huggins has shown that certain hormones ("chemical messengers" produced by the body), which regulate the normal activities of prostatic cells, have a marked influence as well on many of the cancers that derive from them. By the utilization of this knowledge he has been enabled to control the growth of the cancers and of such secondary tumors as may already have formed in distant organs. These discoveries have large theoretical as well as practical implications.

Dr. William J. Robbins, chairman of the National Science Fund and director of the New York Botanical Garden, said that formal presentation of the award will be made to Dr. Huggins later this spring at the annual dinner meeting of the board of directors of the fund. Dr. Robbins also announced that a second Charles L. Mayer award of \$2,000 for an outstanding study made in the same field in 1943 will be given and that entries and recommendations for consideration for this award should be in the office of the National Science Fund, 515 Madison Avenue, New York City, by January 15, 1944. He also emphasized that the advisory committee is interested primarily in fundamental studies on the factors influencing growth of

animal cells rather than applications to any particular aspect of normal or abnormal growth.

ELECTION OF FELLOWS OF THE ROYAL SOCIETY

THE Royal Society, London, on March 18 elected the following scientific men into the Fellowship:

Bhatnagar, Shanti Swarupa, Kt. Director of scientific and industrial research, India. Distinguished for his numerous contributions to physical chemistry, more especially to magneto-chemistry. As professor of chemistry in the University of the Punjab he built up a flourishing school of research. Since the outbreak of war he has organized a new scientific department of the Government of India.

Buxton, Patrick Alfred. Director of the department of entomology, London School of Hygiene and Tropical Medicine. Distinguished for his researches in medical entomology with special reference to the conditions under which insects responsible for the transmission of diseases multiply and the measures which must accordingly be adopted for their control.

Daly, Ivan de Burgh. Professor of physiology, Edinburgh. Distinguished as an originator of essential items of modern physiological technique and for his important contributions to the physiology of the circulation in the lungs and the bronchial tubes.

Edgell, John Augustine, K.B.E. Vice-Admiral R.N. Hydrographer of the Royal Navy. Distinguished for the organization and encouragement of work in tidal research, in determining gravity at sea and in magnetic and electric survey of the oceans.

Ewins, Arthur James. Director of research, May and Baker Ltd. Distinguished for his chemical and biochemical researches. His work in organizing an industrial research laboratory has led to the production of some of the most important synthetic remedies in recent years.

Felix, Arthur. Bacteriologist, Lister Institute. Distinguished for his contributions to serology and bacteriology. He is particularly associated with the Weil-Felix reaction for the diagnosis of typhus fever and with the antigenic analysis of bacteria.

Fleming, Alexander. Professor of bacteriology, St. Mary's Hospital. Distinguished for his contributions to bacteriology, immunology and chemotherapy. His work includes the very important discoveries of lysozyme and penicillin.

Fox, John Jacob. Government chemist. Distinguished for his application of physical methods to the discovery of the structure of chemical substances and for his work on new analytical methods and chemical processes.

Greaves, William Michael Herbert. Astronomer Royal for Scotland. Distinguished for his contributions to stellar spectro-photometry and for the discussion of the color temperatures of early type stars.

Harland, Sidney Cross. Plant breeder. Distinguished for his contributions to the study of genetics and especially of the cotton plants. His researches have not only been of practical value for tropical agriculture but have led to

important advances in fundamental aspects of evolutionary theory.

Kon, George Armand Robert. Research professor of chemistry at the Royal Cancer Hospital. Distinguished for his researches in organic chemistry. During recent years his work on the polyterpenes has provided the basis for a number of important developments.

McCance, Andrew. Director and general manager, Messrs. Colville's Ltd., Motherwell. Distinguished for his work in the steel industry and particularly for his applications of physical chemistry to the processes of steel making.

Penfield, Wilder. Director of the Montreal Neurological Institute. Distinguished for his researches in neuro-histology and as a neuro-surgeon.

Pilgrim, Guy Elcock. Formerly superintendent of the Geological Survey of India. Distinguished for his contributions to the geology of India, particularly in the field of Tertiary stratigraphy, and for his researches in vertebrate paleontology.

Stradling, Reginald Edward. Chief adviser, research and experiments department, Ministry of Home Security. Distinguished for his researches on the properties of building materials and for his direction of the Building and Road Research Stations and of the researches relating to civil defense.

Sykes, Charles. Superintendent of the metallurgy department of the National Physical Laboratory. Distinguished for his fundamental scientific research.

Synge, John Lighton. Professor of applied mathematics, Toronto. Distinguished for his contributions to mathematics, particularly to the geometry of dynamics, the theory of relativity, hydro-dynamics and electricity.

Temple, George Frederick James. Professor of mathematics, Kings College, London. Distinguished for his contributions to mathematical physics, particularly to quantum theory, relativity and mechanics.

Du Toit, Alexander Logie. Lately consulting geologist to the De Beers Consolidated Mines. Distinguished for his contributions to the geology and petrology of South Africa, particularly his work on the Karroo system and his comparative study of the equivalent succession of South America.

Zuckerman, Solly. Professor of anatomy, University of

Birmingham. Distinguished for his studies on the morphology and relationship of the primates and on their reproductive physiology. He has also made outstanding contributions to the study of social behavior in the lower primates.

MEDAL DAY OF THE FRANKLIN INSTITUTE, PHILADELPHIA

MEDAL DAY ceremonies of the Franklin Institute will be held on Wednesday evening, April 21, at half past five o'clock and will open with a reception to the medalists at which a portrait of Past-president P. C. Staples will be unveiled. A dinner and the presentation of awards will follow.

Certificate of Merit to Carl S. Hornberger, Central Scientific Company, Chicago. The Longstreth Medals jointly to Robert Griffin De La Mater and William Schwemlein, the Parkersburg Rig and Reel Company, W. Va. The Wetherill Medal to Robert Howland Leach, Vice-president, Handy and Harman, Bridgeport, Conn. The Brown Medal (posthumously) to Albert Kahn, Albert Kahn Associated Architects and Engineers, Inc., Detroit. Received by Mrs. Kahn. The Henderson Medal to Harry Miller Pflager, senior vice-president, General Steel Castings Corporation, Illinois. The Levy Medal to Anders Henrik Bull, assistant engineer, Board of Transportation of the City of New York. The Potts Medals to Francisco Ballén, director, National Guano Administration, Lima, Peru, and Paul Renno Heyl, National Bureau of Standards. The Cresson Medal to Charles Metcalf Allen, professor of hydraulic engineering, Worcester Polytechnic Institute. The Franklin Medal and Certificate of Honorary Membership to George Washington Pierce, Rumford professor of physics, emeritus, and Gordon McKay professor of communication engineering, emeritus, Harvard University, and to Harold Clayton Urey, professor of chemistry and executive officer, department of chemistry, Columbia University.

Following the presentation of the awards Dr. Pierce will make an address entitled "Songs of Insects" and Dr. Urey will speak on "The First Ten Years of Heavy Hydrogen."

SCIENTIFIC NOTES AND NEWS

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, will deliver the Pilgrim Trust lecture at Burlington House, London, on May 6. The Pilgrim Trust sponsors an exchange of lectures on alternate years between the National Academy of Sciences and the Royal Society.

THE Charles Frederick Chandler Medal, awarded annually by Columbia University for noted achievements in the field of chemistry, has been given this year to Willard H. Dow, of Midland, Mich., president of the Dow Chemical Company. The Chandler Medal was established in 1910 in honor of Professor Chand-

ler, a pioneer in industrial chemistry. The presentation to Mr. Dow will take place on May 20 in Hämeyer Hall, when he will deliver the Chandler lecture.

THE Egleston Medal of the Columbia University Engineering Schools Alumni Association has been awarded to Thomas H. Chilton, director of the technical division of the engineering department of E. I. du Pont de Nemours and Company, Wilmington, Del., for "distinguished engineering achievement." The award is made in recognition of "outstanding achievements in the discovery and formulation of principles underlying the unit operations of chemical engineer-

the more
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ing and in the application of these to process development, to equipment design and to chemical plant construction and operation." The presentation will be made at the seventy-second annual dinner of the engineering alumni on April 29.

THE council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane Prize for 1938-1942 to Sir William Wright Smith, regius professor of botany at the University of Edinburgh, "for his papers within the period of the award, and in recognition of his valuable contributions to systematic botany."

THE faculty of medicine of the University of Berne has conferred the degree of doctor of pharmacy, *honoris causa*, on Dr. Arthur Stoll, of Basle, in recognition of "his contributions to the chemistry of medicinal plants." Our correspondent writes that "Dr. Stoll was first to describe new methods to isolate active principles of drugs heretofore available only in the form of unstable galenicals. The isolation in pure form of such principles has not only widened their therapeutic application, but has opened entirely new indications owing to specific actions not obtainable with the crude drug (*i.e.*, ergotamine). This is the first time the faculty of medicine of the University of Berne has conferred this honorary degree."

IT is stated in *Nature* that Dr. Leslie H. Lampitt, chief chemist and a director of Messrs. J. Lyons and Co., Ltd., has been awarded the medal of the Society of Chemical Industry, given for conspicuous services to the society. Dr. Lampitt has served on the council of the society for many years and has been its honorary foreign secretary and is now its honorary treasurer. He is also chairman of the Chemical Council. He has published many researches on foodstuffs.

THE Council of the British Institution of Naval Architects has awarded the Gold Medal of the institution for the year 1942 to W. C. S. Wigley, for his paper "Calculated and Measured Wave Resistance of a Series of Forms Defined Algebraically, the Prismatic Coefficient and Angle of Entrance being Varied Independently." The Wakeham Prize for 1942 has been awarded to N. Hancock for his paper, "Blade Thickness of Wide-Bladed Propellers."

THE American Association of Dental Schools has elected the following officers: *President*, Allen T. Newman, of New York University; *President-elect*, F. W. Hinds, of Baylor University; *Vice-president*, Alvin W. Bryan, of the State University of Iowa. Carl O. Flagstad, of the University of Minnesota, was re-elected secretary-treasurer. The 1944 meeting will be held at the Drake Hotel, Chicago.

DR. JURGEN RUESCH, of Zurich and Basle, has been appointed lecturer in psychiatry at the Medical School of the University of California, San Francisco. Since the outbreak of the war he has held a Rockefeller Foundation fellowship and has been working in Boston hospitals and at the Harvard Medical School.

DR. DAVID L. COFFIN, instructor in veterinary pathology at the University of Pennsylvania, has been appointed to the Herbert Fox Memorial Fellowship in comparative pathology at the Zoological Society of Philadelphia. Dr. Coffin, who is the first incumbent of the fellowship, will serve as assistant to Dr. Herbert L. Ratcliffe, recently appointed director of the Penrose Research Laboratory of the Zoological Society and assistant professor of comparative pathology at the University of Pennsylvania.

DR. EDGAR C. BAIN, a member of the research staff of the U. S. Steel Corporation since 1928, has been appointed vice-president of the Carnegie-Illinois Steel Corporation, principal subsidiary of the U. S. Steel Corporation, in charge of research and technology. Dr. Bain is an authority on alloy steels.

COLONEL JAMES STEVENS SIMMONS, director of the Division of Preventive Medicine, Office of the Surgeon General, U. S. Army, has been made a brigadier general with rank from March 14.

MALCOLM E. CAMPBELL, senior cotton technologist in charge of the technical research program of the cotton and fiber branch of the Department of Agriculture, has joined the staff of the Textile Research Institute, Inc., where he will supervise applied and cooperative research activities.

DR. GAYLORD W. ANDERSON, on leave from his post as head of the division of preventive medicine and public health of the Medical School of the University of Minnesota to serve in the Office of the Surgeon General of the Army, has been made head of the division of medical intelligence. The division compiles health, climatic and sanitation evidence with respect to every area to which United States troops may be sent and stands ready at a moment's notice to supply such information to the medical officers of detachments sent anywhere in the world. Such matters as the types of insects, snakes and other possibly dangerous creatures, diseases peculiar to the area, degrees of heat and humidity, poisonous plants, necessary dietary precautions, probable purity of the water supply and the like are included in comprehensive surveys.

It is reported in the daily press that Professor Ray G. Johnson, head of the department of animal husbandry of Oregon State College, has arrived in Chungking at the invitation of the Chinese Ministry of Education. He will give a series of lectures on animal

husbandry in various universities and colleges in Free China and will make an extensive tour of the Northwest, where he will study the development of animal husbandry.

THE nineteenth Lewis Linn McArthur Lecture of the Frank Billings Foundation of the Institute of Medicine of Chicago will be delivered at the Palmer House on Friday evening, April 23, by Dr. Chester M. Jones, of the Massachusetts General Hospital, Boston. He will speak on "The Relationship between the Nervous System and Pain Perception with Particular Reference to the Gastro-intestinal Tract."

THE commencement address at the Hahnemann Medical College and Hospital was given on March 25 by Dr. Haven Emerson, professor of public health, Columbia University.

DR. WILLIAM E. LADD, professor of child surgery, Harvard Medical School, Boston, delivered the first Béla Schick Lecture at Mount Sinai Hospital on April 13. His subject was "Time and Choice of Operation in Early Life." The lecture is one of a series planned in honor of Dr. Béla Schick, now consultant and formerly pediatrician in chief at the Mount Sinai Hospital and is made possible by a fund contributed in 1942 by his friends and associates.

THE annual Hughlings Jackson Memorial Lecture of the Montreal Neurological Institute will be given on April 28 by Professor Philip Bard, of the department of physiology of the Johns Hopkins Medical School. The title of the lecture will be "Re-representation as a Principle of Central Nervous Organization."

THE Association of Southeastern Biologists will not hold its annual meeting this spring. Dr. Mary S. MacDougall is president and Dr. Martin D. Young, of the U. S. Public Health Service, Columbia, S. C., has been elected secretary-treasurer.

THE March number of *The American Journal of Physical Anthropology*, which has just appeared, marks the beginning of a new series under a new editor. Dr. Aleš Hrdlička, who founded the journal in 1918 and carried it through the first twenty-nine volumes, has resigned in favor of an editorial board representing the American Association of Physical Anthropologists. This board consists of Dr. T. D. Stewart, of the U. S. National Museum, *Managing Editor*; Dr. Mildred Trotter, of Washington University; Dr. Wilton M. Krogman, of the University of Chicago; Dr. William W. Greulich, of Western Reserve University, and Dr. Carl C. Seltzer, of Harvard University, *Associate Editors*.

YALE UNIVERSITY has established eight research fellowships amounting to \$20,000 for the year beginning July 1. The fellowships, which are in the field

of the humanities and sciences, are under the auspices of the Committee on Liberal Studies under the chairmanship of Professor Chauncey B. Tinker. They will be open to young scholars of the United States or Canada for a year's research at Yale and will pay the recipient \$2,500 a year. Although the normal appointment for these fellowships is a full academic year (ending in July, 1944), applications are nevertheless accepted from qualified men and women who may be able to spend only a part of the year upon the fellowship. Applicants should possess the Ph.D. degree, and preference will be shown to those who have demonstrated a capacity for independent research. Applications should be addressed to the Dean of the Graduate School at Yale and must be received on or before May 10. Announcements of awards will be made on May 20.

A GIFT is announced of about \$50,000 to the Medical School of Tufts College from Dr. and Mrs. George G. Averill, of Waterville, Me. Dr. Averill, who is a graduate of the school, had previously made a similar contribution.

GIFTS amounting to nearly \$80,000 were made to New York University during February and March. The largest single item was \$17,625, which was contributed by alumni and friends of the College of Medicine through Dean Currier McEwen towards an emergency fund made necessary by the accelerated program of training physicians for the war effort. Other alumni contributed \$5,000, through the Alumni Fund, toward general university expenses. The sum of \$48,844 was contributed to the College of Medicine, much of it for research in such fields as metabolism, nutrition, neurology, psychiatry, anesthesia and surgery, the need for which has been stimulated by the war. Gifts were reported from the Williams and Waterman Fund of the Research Corporation, the Lucius N. Littauer Foundation, Inc., the Carnegie Corporation, Josiah Macy, Jr., Foundation, the National Committee for Mental Hygiene and many others.

THE Johns Hopkins University has established a special course to train technicians in the use of industrial instruments and controls. The Brown Instrument division of the Minneapolis-Honeywell Regulator Company is cooperating in the program by assigning as guest lecturers members of its Philadelphia technical staff. They will explain the working of such instruments as the recently developed electronic potentiometer, the Radiamatic pyrometer and air-operated process controls. Sixty picked men from war plants in this area are attending the classes, which include both lectures and laboratory instruction in the principles of temperature measurement and use

and maintenance of control instruments. They are under the direction of Dr. R. B. Anderson.

THE first completed section of the Hall of New World Archeology was opened to the public at Field Museum of Natural History early this year. According to Dr. Paul S. Martin, chief curator of the department of anthropology, under whose supervision the new exhibits were designed and prepared, the hall marks the beginning of an era of improved techniques in the exhibition of anthropological material. The material used is largely from expeditions conducted by Dr. Martin and associated archeologists. The section now being opened bears the title "Indian America," and presents "streamlined" exhibits of the New World civilizations as the white men found them when they invaded the western hemisphere. Later, other sections of the hall will be completed. Besides Dr. Martin members of the museum staff who played an important part in the planning of the hall are Donald Collier, assistant curator of North American archeology; Mrs. Alexander Spoehr, artist, and Alfred Lee Rowell, dioramist. Dr. Alexander Spoehr,

assistant curator of North American ethnology and archeology, also had a great deal to do with the conception and preparation of the hall, but he is now on leave of absence from the museum as an ensign in the U. S. Navy. Another staff member, Dr. John Rinaldo, research associate, who made contributions to the new exhibits, is serving in the Army as a staff sergeant.

THE British Secretary for the Colonies, according to *The Times*, London, has approved a recommendation of the Colonial Advisory Council of Agriculture and Animal Health that its functions should be extended to include forestry. The council will accordingly in future be known as the Colonial Advisory Council of Agriculture, Animal Health and Forestry. Additional members will be appointed to the council to advise on forestry matters, and a Forestry Committee will shortly be set up. The Duke of Devonshire, as successor to Harold Macmillan, Parliamentary under-secretary for the Colonies, has assumed chairmanship of this council; the vice-chairman is G. L. M. Clauson, assistant under-secretary.

DISCUSSION

THE COMPLEX VITAMIN B COMPLEX

THE existence of thirteen vitamins is now commonly accepted. Of these, eight are members of the so-called vitamin B complex. Of the latter group thiamine (B_1), riboflavin (B_2), pyridoxine (B_6), nicotinic acid, pantothenic acid and biotin are recognized as vitamins by all workers, but there is not complete agreement as to whether inositol and choline (or a choline-like factor) should be so classified. The status of para-aminobenzoic acid as a vitamin still is indefinite.

During comparatively recent years, discoveries of more than twenty additional B vitamins have been announced from competent laboratories. Some of these, however, have been eliminated by the isolation of the eight members referred to above. That seems to have been the case with vitamins B_3 , B_4 and B_5 . This elimination process no doubt will be applied to other B vitamin designations.

The isolation of a new vitamin is important for several reasons: (1) it adds to our knowledge of nutrition, (2) it offers hope of chemical identification and synthesis of the compound, (3) it makes possible further advances through incorporation of the pure vitamin into synthetic diets and (4) it simplifies the list of vitamins by eliminating some of those previously announced.

Early in 1940 it was reported from the laboratory of one of us¹ that under certain dietary conditions chicks grow slowly, and develop a severe anemia which

can be cured with liver extracts. The responsible factor was recognized as an unidentified member of the B complex and for convenience it was designated as vitamin B_c .

Although other factors required for the growth of the chick have been announced (factors U, R, S and the norit eluate factor) the anemic condition in relation to vitamin B deficiency has not been observed by others prior to 1942. Recently, however, Mills, Briggs, Elvehjem and Hart² have verified this claim. They state that "the occurrence of anemia on our basal ration and its prevention by the norite eluate factor is suggestive of the identity of the norite eluate fraction with Hogan's antianemic factor." They also point out that the factors listed above, together with "folic acid," possess certain similarities.

Since the 1940 reports, research workers in our laboratories have consistently verified the claims made in respect to vitamin B_c and have extended the work. The first of their joint progress reports appears in this number of SCIENCE and as a result of that, and of future publications, it is reasonable to expect a simplification of the vitamin B problem.

A. G. HOGAN

DEPARTMENT OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF MISSOURI

OLIVER KAMM

PARKE, DAVIS AND COMPANY,
DETROIT, MICH.

¹ A. G. Hogan and E. M. Parrott, *Jour. Biol. Chem.*, 132: 507, 1940.

² R. C. Mills, G. M. Briggs, Jr., C. A. Elvehjem and E. B. Hart, *Proc. Soc. Exper. Biol. and Med.*, 49: 186, 1942.

PHENOTHIAZINE FOR CATTLE LICE CONTROL

SUCCESSIVE trials using phenothiazine as a dust has proven this compound to be very effective against the short-nosed cattle louse, *Haematopinus eurysternus* (Nitzsch), and the long-nosed cattle louse *Linognathus vituli* (Linné). The insecticide, diluted with equal parts of white flour, was applied to twelve infested animals located in various parts of North Dakota. A 100 per cent. mortality of these sucking lice was obtained in every trial. It failed to kill, however, the chewing cattle louse, *Bovicola bovis* (Linné). Twelve hours after applying this mixture to two heavily infested bulls the chewing lice had discontinued feeding and were scattered throughout the hair; however, when the animals were examined the following day the lice had moved to the skin and were actively feeding. A mixture of sodium fluosilicate two parts, phenothiazine one part, and white flour one part, gave excellent control of both sucking and chewing types of lice. It is entirely possible that effective control may be achieved by increasing the diluent and decreasing the amount of phenothiazine or sodium fluosilicate. This phase of experimentation is now under way at the North Dakota Agricultural Experiment Station. In view of the limited supplies of rotenone and pyrethrin, both effective louse powders, this phenothiazine dusting mixture may replace these imported insecticides.

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EARLY AND LATE EASTER DATES

MARCH 24 is the most unusual Gregorian Easter date. Three years ago, in 1940, it occurred for the second time since the Gregorian calendar reform (1582). An interval of 451 years separates 1940 from 2391, the next year having March 24 as the Gregorian Easter date.

March 22 is the earliest possible Easter date. Although it occurred four times since the calendar reform, a record interval of 467 years will elapse between 1818 and 2285, the years of the latest and of the next return of March 22 as the Gregorian Easter date.

April 25 is the latest possible Easter date. Between the time of the Gregorian reform and the end of the nineteenth century, all the possible Easter dates—except March 24 and April 25—had occurred at least four times. In 1943, Easter Sunday will fall, for the fourth time, on April 25 in the Gregorian calendar. If one of the current calendar reform projects—all of which object to late Easter dates—should be adopted within the lifetime of the next two or three generations, April 25, 1943, may mark the last occurrence of this latest possible Easter date.

GREGORIAN EASTER DATES¹

March 22	March 23	March 24	April 24	April 25
1598				
1693	1636		1639	1666
	1704		1707	1734
1761	1788	1799	1791	
1818	1845		1859	
	1856			1886
	1913	1940		1943
	2008		2011	2038
		2160	2163	2190
2285	2228		2231	2258
2353	2380	2391	2383	2326

ALEXANDER POGO

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SPECIAL CORRESPONDENCE

THE WORK OF SOVIET BOTANISTS¹

THE war, demanding a tremendous concentration of the forces of the whole people of the U.S.S.R., has also put forward a number of problems to be solved by the botanists. First and foremost, the huge expenditure of bandaging materials made it necessary for us to search for other than the raw materials ordinarily used for this purpose. In Russia and in a number of other countries during the World War of 1914-1918, sphagnum (peat bog moss) was used for this purpose.

¹ Radioed to the American Association of Scientific Workers by Sergei Pilipchuk, secretary of the Soviet Scientists Antifascist Committee and forwarded to

At the very beginning of this war, work on the study and preparation of sphagnum was begun by the Institute of Botany of the Academy of Sciences of the U.S.S.R. situated in Leningrad. Large quantities of sphagnum were easily available in numerous peat bogs in the Leningrad district. Sphagnum, thanks to the peculiar structure of its cells, has excellent absorbent qualities. The moss is carefully cleaned of all extraneous matter, dried, steam sterilized and made into gauze-covered pads of various sizes.

Experience has shown that wounds heal much more

SCIENCE by Dr. Harry Grundfest, of the Rockefeller Institute.

¹ In the table published in SCIENCE, 91: 292, 1940, two dates have been inadvertently omitted.

quickly with sphagnum bandages than with cotton-battening bandages. This is explained by the fact that, in addition to its draining qualities, the moss also contains certain disinfecting substances.

Under the guidance of botanists, large quantities of sphagnum bandages were prepared for the Leningrad front, and a short pamphlet on the gathering and preparation of moss was printed. Sphagnum is now prepared on a large scale in the northern regions of the Soviet Union.

Another item of interest to botanists was the preparation of fir balsam from the sap of fir trees. This balsam, mixed with other substances, has been used in many Leningrad hospitals for treatment of fresh wounds. The demand for this balsam is increasing rapidly as doctors are becoming acquainted with its use and its qualities. The number of fir trees in Siberia and the northern regions of European Russia is enormous and fir balsam can be prepared in unlimited quantities.

The search for vitamin-bearing plants has also given botanists a large amount of wartime work. Everybody knows the value of vitamins to the human organism, but in wartime these substances are more than ever essential. One of the most important of these substances is vitamin C. Even before the war it was known that one of the richest sources of vitamin C is the wild rose hip. Since the war, vitamin contents of hips in the eastern and northern districts of the U.S.S.R. have been studied to discover where the vitamin content is greatest. In some places wild roses have been planted in order to produce hips rich in vitamin. The collection and delivery of hips has been organized on a large scale. Hips of certain roses of Central Asia have been found particularly rich in vitamins and these sorts are being specially cultivated.

It has recently been discovered that green unripe walnuts growing in dense forests in Central Asia also contain vitamin C. Collection of these nuts and manufacture of vitamin-bearing preparations had been organized.

Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. Biochemists in Moscow and Leningrad have

organized mass production of vitamin C concentrate from pine needles. Despite the fact that the percentage of vitamin contained in needles is very small, this source of vitamin C is of particular value to us on account of the huge pine forests throughout the whole territory of the Soviet Union with the exception of the Arctic and desert regions.

During the long siege of Leningrad lack of vitamin C made itself particularly felt, and the decoction made from pine needles played an important role in the prevention of scurvy. In its impure state the liquid has a bitter flavor, but a number of proposals have already been made for freeing the liquid of its bitterness. Since the war began, a number of grasses have also been discovered to contain vitamin C.

Botanists have taken an active part in gathering wild medicinal plants; in cultivation of plants for the manufacture of insecticides; and in the discovery of new plants which might be used medicinally.

Attention has also been paid to a number of wild plants which can be used as salads, for example, the dandelion, primrose, etc. Attention has also been devoted to the roots of other plants rich in starch and inulin, and to fruits of a number of wild trees and shrubs such as bird cherry, hawthorn and rowan. A flour is produced from dried rowan berries which may be added to ordinary flour in proportion up to 25 per cent. and used for baking pastry, etc. Flour made from bird cherries gave excellent results in cakes. These are all results of work done by botanists to help the inhabitants of Leningrad during the siege of last winter.

Much has also been done to find substitutes for tea and coffee among wild-growing flowers. One item of particular interest is the publication of an illustrated pamphlet for guerillas and raiding troops operating behind enemy lines, giving details of all wild-growing edible plants.

These are some of the ways in which botanists are employing their science in the service of the great cause of the war against Hitlerism.

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SCIENTIFIC BOOKS

ORGANIC CHEMISTRY¹

Organic Chemistry. By W. T. CALDWELL. 760 pp. Houghton, Mifflin Company. \$4.25.

THIS is an excellent text. It is carefully written and each subject is dovetailed into the following one with clear argument, proper insistence, repetition and

¹ Corrected proof was received shortly before the recent death of Dr. Powell.

reference, and with a cunning use of items of historical interest, a use which argues authorship by a person who delights in exposition as an art. The printing is well done, the formulae are clear, the pages please the eye and the reading pleases the mind. It is remarkable not only for the arrangement and style but also for its comprehensiveness and accuracy. It is thoroughly up-to-date and yet never fails to place the newer items of theoretical or practical interest in

a framework which does not exaggerate their importance. This is an item too often neglected and it argues much for the sincerity of the author that he takes upon himself such obligation of balancing the new and spectacular against the old and dulled. It is suitable for a three-semester course in organic chemistry and yet so arranged that it can be left safely in the hands of a student for general reading preparatory to advanced work. No literature references or questions are included in the text and the saving of space so achieved is turned to good purpose in the inclusion of material and argument. This reviewer hopes that the merit of the work will be rewarded with widespread use. It is deserving of the widest support and is the best general text in organic chemistry that he has seen for many years.

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BLOOD GROUPING

Blood Grouping Technic. By F. SCHIFF and W. C. BOYD. Interscience Press, 1942.

THIS book by two outstanding investigators in the field of blood grouping is an authoritative compilation of methods of grouping, based in large degree on the experience of the authors themselves. While the book is supposed to be a translation and amplification of Schiff's small manual which enjoyed a well-deserved popularity for a long time in Germany, it is really a new book. The arrangement of the material is quite different and the book is nearly three times as large as the German manual on account of the inclusion of much new material. It is unfortunate that Dr. Schiff did not live to see this fine book in print, but the work was capably brought to its completion by Dr. Boyd.

The monograph opens with a brief introductory chapter outlining what is known of the individual differences in human blood and the secreting factor. In the succeeding extensive chapter, the general technic of blood grouping is described in great detail, including methods for determining the four blood groups, the subgroups of groups A and AB, the M-N types and the Rh-type. Detailed instructions are given for carrying out tests not only on blood by direct agglutination and hemolysis, but also on organs and secretions by the technics of absorption, inhibition and

complement fixation. In addition, full directions are given for the preparation of suitable grouping sera, including immune sera in rabbits against agglutinogens A, B, M and N. In the remaining chapters of the book, further refinements in the technic are presented from the point of view of the specialized requirements in relation to the practical applications of the tests in blood transfusion, in forensic medicine in cases of disputed parentage and for the examination of blood stains and in anthropology.

Of considerable interest is the section discussing the anthropological significance of the blood groups, especially since Dr. Boyd has made significant contributions to this subject. Among the theories mentioned to explain the differences in the present distributions of the blood groups genes throughout the world the most plausible is that favored by Bernstein and Candela that there were originally two or more races, each belonging predominantly to one or two of the four blood groups, and that the present distribution in white races arose by crossing between the original races. Boyd himself, however, proposes a monophyletic theory and postulates that man originally had a blood group distribution represented approximately by the frequencies p (A) = 0.35, q (B) = 0.15 and r (O) = 0.65, and that as man spread to the four corners of the world, isolated groups by chance lost largely one or two of the three genes. The weak point in this theory is that no attempt is made to explain how the original blood group distribution arose, nor to apply to man the observations on apes and lower monkeys. To the reviewer the polemic between the sponsors of the monophyletic and polyphyletic theories appears largely academic, since undoubtedly numerous times in man's history there must have been periods of migration, isolation and inbreeding succeeded by periods of invasion and mixing of races. Accordingly, as the authors of the manual will probably agree, the choice between the two theories would depend to a great extent on the time selected as the onset of man's history as a distinct species.

All in all this book on blood grouping technic constitutes a valuable contribution and one destined to serve as a standard and authoritative reference work on the subject for a long time to come.

A. S. WIENER

SPECIAL ARTICLES

ENZYME SYSTEMS CONTAINING ACTIVE SULFHYDRYL GROUPS. THE ROLE OF GLUTATHIONE¹

UP to now there has been published scattered information on this subject, and from time to time there

¹ From the Chemical Division, Department of Medicine, the University of Chicago.

have appeared observations on the presence of -SH groups essential for enzyme activity among some hydrolytic enzymes, certain lipid-splitting enzymes, several pneumococcal and streptococcal hemolysins, and a few oxidation enzymes. A comprehensive study of the presence of -SH groups essential for

enzyme activity was considered therefore necessary. The activity of the enzyme systems was measured in the presence of iodoacetamide, chloromercuribenzoic acid and organic arsenicals.² Reactivation was studied by addition of glutathione after the enzyme had remained in contact with the inhibitor for about 10 minutes.

Enzymes for Carbohydrate Metabolism: Some evidence for the presence of -SH groups in pyruvate oxidase could be found in the inhibition produced by 2,6-dichlorophenol indophenol, and quinone reported by Barron³ and in the increase of the rate of pyruvate oxidation and of acetoacetate synthesis by ground avian liver on addition of glutathione (Table I). The

TABLE I

THE EFFECT OF GLUTATHIONE (GSH) (0.01 M) ON THE OXIDATION OF PYRUVATE AND ON THE FORMATION OF ACETO-ACETATE

FIGURES GIVE CMM. PER HR. GROUND PIGEON LIVER: BUFFER, NaCl-Phosphate, pH 7.4; CONCENTRATION OF PYRUVATE, 0.01 M

	Control	GSH
O ₂ uptake	241	371
Pyruvate utilization	174	378
Aceto-acetate formation	40.2	114.6

presence of -SH groups in the protein seems necessary not only for pyruvate oxidation, but also for pyruvate dismutation, and pyruvate condensation (CO₂ fixation ?), (Table II). In these experiments, pyruvate oxidation was determined by measurement of O₂ uptake; dismutation by measurement of CO₂ production in bicarbonate-Ringer and N₂:CO₂ as gas phase; and condensation by measurement of ketoglutarate, aceto-acetate, acetyl methylcarbinol and carbohydrate synthesis. Iodoacetamide, chloromercuribenzoic acid and organic arsenicals inhibited these reactions; glutathione reactivated them. Besides pyruvate, the oxidation of malate and of ketoglutarate were inhibited by these reagents and reactivated by glutathione.

Native myosine (adenosine triphosphatase) was inhibited by chloromercuribenzoic acid and reactivated by glutathione.

Enzymes for Nitrogen Metabolism: d-Amino acid oxidase, 1-glutamic acid oxidase, monoamine oxidase and transaminase were inhibited by iodoacetamide, chloromercuribenzoic acid and trivalent arsenicals, and reactivated by glutathione (Table II). Diamine oxidase was not inhibited by these -SH reagents.

Enzymes for Alcohol Oxidation: Dixon⁴ found that

² The organic arsenicals used were: p-carboxyphenyl arsine oxide, 3-amino, 4-hydroxy phenyl-dichloro-arsine HCl, p-amino phenyl dichloro-arsine HCl, p-carbamyl-phenyl arsine oxide, and p-arsine oxide, kindly furnished by Dr. Harry Eagle. p-Chloromercuribenzoic acid was kindly provided by Dr. L. Hellerman.

³ E. S. G. Barron, *Jour. Biol. Chem.*, 113: 695, 1936.

⁴ M. Dixon, *Nature*, 140: 806, 1940.

TABLE II
ENZYME SYSTEMS CONTAINING ACTIVE -SH GROUPS
THEIR INHIBITION WITH IODOACETAMIDE (0.001 M), CHLOROMERCURIBENZOIC ACID (0.001 M), AND ORGANIC TRIVALENT ARSENICALS (0.0001 M), AND THEIR REACTIVATION WITH GLUTATHIONE (0.01 M)

Enzyme system	Inhibition (per cent.)			Reactivation (per cent.)
	Iodoacetamide	ClHg benzoic acid	Organic arsenical	
<i>Carbohydrate metabolism</i>				
Pyruvate oxidation	80	92	87	41
Pyruvate condensation (a ketoglutarate synthesis)				87
Pyruvate condensation (acetoacetate synthesis)				63.5 complete
Pyruvate condensation (carbohydrate synthesis)				95 93
Pyruvate dismutation	96	35.6	93	
Pyruvate condensation (acetyl methyl carbinol formation)	64.5	85	56	complete
<i>a</i> Ketoglutarate oxidation	90	70	98.5	98
Malate oxidation	complete		69.5	80
Native Myosine (adenosine triphosphatase)		90		complete
<i>Nitrogen metabolism</i>				
d-amino acid oxidase	none	complete	90	78
l-glutamate oxidase		87		90
Transaminase		49	81	95
Monoamine oxidase	33.3	82	71	complete
<i>Fat metabolism</i>				
Stearate oxidase (liver)	30	complete	complete	
Stearate oxidase (bacteria)	80	complete	72	
Oleate oxidase (bacteria)	52	complete	complete	
<i>β</i> Hydroxybutyrate oxidase (heart)		complete	complete	
Lipase	none	38	62	72

the oxidation of ethyl alcohol by yeast alcohol oxidase was inhibited by iodoacetate while its oxidation by liver alcohol oxidase was not affected. The same results were found by using the purified activating proteins and measuring the rate of diphosphopyridine nucleotide reduction.

The oxidation of choline by liver choline oxidase was found by Block and Barron⁵ to contain -SH groups essential for activity. Similar findings were observed on the oxidation of glycerol by bacteria.⁶

Enzymes for Fat Metabolism: The presence of -SH groups was found necessary for the activity of the following enzymes concerned with the metabolism of fats: the oxidation of stearate by rat liver extract, and by bacteria (*B. coli*), the oxidation of *β* hydroxybutyrate by animal tissues. Pancreatic lipase was partially inhibited by chloromercuribenzoic acid and by organic arsenic while it was not affected by iodoacetamide (Table II). In these experiments, the oxidation of stearate was measured by the O₂ uptake; the oxidation of *β* hydroxybutyrate, by the rate of reduction of diphosphopyridine nucleotide; pancreatic lipase activity by titration with NaOH.

⁵ B. Block and E. S. G. Barron. To be published.

⁶ E. S. G. Barron, *Bol. Soc. Quim. Peru*, 6: 7, 1940.

Esterases: Nachmanson⁷ has shown that acetyl choline esterase is inhibited by mild oxidizing agents and iodoacetic acid. In agreement with these findings, 3-amino-4-hydroxyphenyl arsine oxide ($6.6 \times 10^{-5} M$) produced 57 per cent. inhibition. In contrast with this esterase, the hydrolysis of mono-n-butyryl by human serum esterase was inhibited by ClHg benzoic acid by only 18 per cent., addition of glutathione bringing partial reactivation; hog liver esterase was inhibited by 31 per cent. with p-carbamyl phenyl arsine oxide, and by 9 per cent. with ClHg benzoic acid; pancreatic esterase was not affected by the -SH reagents.

Proteins containing no -SH groups essential for enzymatic activity: The following enzymes were not affected by the above-mentioned -SH reagents: polyphenol oxidase, arginase, citric oxidase, uricase, catalase, lactic oxidase, liver alcohol oxidase, histaminase, potato phosphorylase, carbonic anhydrase, acid phosphatase, peanut fat oxidase, pepsin, cytochrome oxidase and flavoproteins.

Since such a large number of enzyme systems contain in their protein moiety -SH groups essential for enzyme activity, the role of glutathione becomes of great importance. Glutathione, by maintaining these groups in their reduced form would maintain the enzyme activity of those systems possessing essential -SH groups.

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T. P. SINGER

AUXIN ACTION

MUCH is already known about the results of the action of auxins and similarly behaving compounds in inducing roots to grow on cuttings, in producing parthenocarpy and in affecting the growth of the whole plant, especially at the tips of herbaceous stems where growth activity is most intense. However, the fundamental mechanism is still to be revealed. The purpose of this article is to make known that discovery and to support it with sound evidence.

The mechanism is fundamentally the release of diastase, and possibly sucrase and other enzymes, from the protein colloidal substances to which they are normally attached. Enzymes are partly and considerably inactivated by adsorption onto a colloid as shown by Eyster.¹ A 100 ml solution containing 50 ml 1 per cent. soluble starch and 5 ml 1 per cent. diastase (Merck) and enough water to make a total volume of 100 ml required only 15 minutes for digestion past the last iodine staining stage as shown by the I₂KI test. A similar solution with 1 gram of dry

activated charcoal, added immediately after the diastase was added, required 234 minutes (almost four hours). While ethyl alcohol, ether and chloroform decreased slightly the enzymatic activity of diastase in the absence of a colloidal carrier, they markedly accelerated the activity in the presence of charcoal. This indicates that the narcotics had a stronger influence in releasing the diastase from the charcoal (*i.e.*, enzyme from colloid) than it had in reducing the actual digestive action of the unbound enzyme. It was concluded that associated colloids dominate the effects of chemical agents and of environmental factors on enzymes.

Indole-3-acetic acid, β -(indole-3)-propionic acid, γ -(indole-3)-n-butyric acid and α -naphthaleneacetic acid increase the action of diastase when associated with activated charcoal in proportion to their concentrations. Table 1 presents the data for indole-propionic acid, which was being used at the time of the discovery of the mechanism of growth substances. In each case 50 ml of 1 per cent. soluble starch solution, 5 ml of 1 per cent. diastase solution, and enough indole-propionic acid to give the stated concentration were diluted to 100 ml with distilled water. The concentration of indole-propionic acid is based on the final solution volume of 100 ml. The diastase solution was added last and then there followed immediately the addition of exactly 1 gram of dry charcoal. Each mixture was placed in 125 ml bottles. The temperature of the room and of the component solutions before mixing was close to 25° C. The experiment was done in the evening in the presence of four functioning 100-watt electric light bulbs at an average distance of 8 feet. The influence of light will be clarified later in this article.

TABLE 1
INFLUENCE OF VARIOUS CONCENTRATIONS OF INDOLE-PROPIONIC ACID ON THE ENZYMATIIC ACTION OF DIASTASE ASSOCIATED WITH CHARCOAL

Concentration of indole-propionic acid	Time required for digestion of soluble starch past the last iodine staining stage
0 parts per million	265 minutes
5 "	252 "
10 "	245 "
25 "	230 "
50 "	188 "
75 "	160 "
100 "	126 "
150 "	60 "

Table 2 presents data to show the effect of indole-propionic acid on isolated diastase; *i.e.*, diastase in the absence of charcoal. In this case 50 ml of 1 per cent. soluble starch solution, 1 ml of 1 per cent. diastase solution and enough indole-propionic acid to give the stated concentration were diluted to 100 ml. No charcoal was added. The conditions of temperature and light were the same as in the preceding ex-

⁷ D. Nachmanson and E. Lederer, *Bull. Soc. Chem. Biol.*, 21: 797, 1939.

¹ *Plant Physiology*, 18: in press.

periment. Indole-propionic acid retards the action of the diastase in direct proportion to its concentrations. This explains the inhibiting effect of auxin in starch or sucrose free organs, such as some roots. Roots containing starch or sucrose would be expected to, possibly, show a stimulation in growth upon the addition of auxin. It is also expected that organs containing starch or sucrose but with an ample supply of unbound enzyme are inhibited in their growth in the presence of additional auxin.

TABLE 2

INFLUENCE OF VARIOUS CONCENTRATIONS OF INDOLE-PROPIONIC ACID ON THE ENZYMATIC ACTION OF DIASTASE NOT ASSOCIATED WITH CHARCOAL

Concentration of indole-propionic acid	Time required for digestion of soluble starch past the last iodine staining stage
0 parts per million	105 minutes
5 "	112 "
10 "	117 "
25 "	130 "
50 "	150 "
75 "	172 "
100 "	195 "
150 "	235 "

Phototropism can be demonstrated by running a series of charcoal-diastase-soluble starch mixtures in varying light intensities, inasmuch as the charcoal system is extremely sensitive to light. Light accelerates the rapidity with which the enzymes are bound to the colloid. The mixtures were similar to those

TABLE 3

INFLUENCE OF VARIOUS INTENSITIES OF LIGHT ON THE ENZYMATIC ACTION OF DIASTASE ASSOCIATED WITH CHARCOAL

Condition of light	Time required for digestion of soluble starch past the last iodine staining stage
Total darkness	234 minutes
Artificial light at night	265 "
Weak diffuse natural light in day	415 "
Strong diffuse natural light in day	605 "

used in Table 1, except no auxin was added. Table 3 presents the data.

Daylight with its ultra-violet and blue-indigo-violet

light components is very potent in accelerating the rapidity with which enzymes are bound to a colloidal carrier, consequently making the enzymes less free to act. Artificial light has very little influence, as expressed also in its reaction on growth of plants. Since there was more rapid digestion by the charcoal-bound diastase in the dark than in the light, this explains the greater growth of the stem tip on the shaded side than on the illuminated side. Growth substances merely aid in releasing the enzyme from the colloid, especially after it has been rather securely adsorbed by the influence of many continuous hours of strong natural illumination. This explains why growth substances are not specific, but include a great variety of substances from the indole compounds to ethylene and carbon monoxide. Any substance which releases the digestive enzyme from its colloidal carrier, or slows the rate at which the enzymes are being bound to the colloid, without unduly upsetting any vital process, can apparently act as a growth substance. The indole compounds are more satisfactory because they are milder in their effect. They liberate sufficient enzyme to bring about the formation of digested foods in a quantity large enough to prevent suitable forms of food from being a limiting factor, and still just mildly affect membrane permeability and other cellular properties and functions.

Light is effective in building up food reserves for the plant, and in causing the digestive enzymes to be bound to their colloidal carriers more securely. Auxin releases the enzyme from its colloidal base and makes it free to act. Indications are both that in phototropism the auxin does not shift from the illuminated side to the shaded side, and that it is neither metabolically used up nor destroyed in the light, but that correspondingly more auxin is needed in cases where the enzyme has been more strongly adsorbed—a condition which is directly proportional to light exposure.

A more complete discussion and additional presentation of data will follow elsewhere.²

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID AND ACCURATE MICRO METHOD FOR THE ESTIMATION OF THE SULFONAMIDES

THE analysis of body fluids for the sulfonamides is a subject of clinical importance. The method of Bratton and Marshall¹ is at present most widely used, though it has several shortcomings. The method con-

sists of precipitating the protein of the fluid with trichloracetic acid, filtering, diazotizing the aryl amine in the filtrate with nitrous acid, adding ammonium sulfamate to destroy the excess nitrous acid and coupling the diazonium salt with N-1 naphthyl ethylene diamine. The color intensity of the azo dye

¹ A. C. Bratton and E. K. Marshall, Jr., *Jour. Biol. Chem.*, 128: 537, 1939.

² Subsequently, it has been found that the auxin, too, is adsorbed in a manner similar to the adsorption of the enzyme.

solution is a measure of the sulfonamide content of the fluid.

The time for a single determination is exceptionally long, and the color which is formed is stable for no longer than one hour, so that it is impossible to run a large number of samples simultaneously. The nitrogen bubbles which form after the addition of the sulfamate often lead to false readings. The recovery of sulfathiazole from blood is low, and is only about 80 to 85 per cent. when the blood is precipitated in trichloracetic acid in a volume ration of 1:20.

Changes in the procedure have removed all the causes for these objections. In the micro method, the blood is precipitated with trichloracetic acid containing a small amount of sulfuric acid. Then sodium nitrite in excess is added to the filtrate, and ethyl alcohol added to the solution of the diazonium salt. The coupling with *N*(1-naphthyl)ethylene-diamine is carried out in this solution. It was found unnecessary to add the ammonium sulfamate, the color being more stable in its absence.

It was shown that the blood need not be laked prior to precipitation of the protein in order to obtain complete recovery of the sulfonamides. This is pointed out in Table I, together with comparative results obtained by the Bratton and Marshall procedure.

TABLE I
FREE SULFATHIAZOLE LEVELS—(MG PER CENT.)

Subject and dose	Regular Bratton and Marshall method	Micro method		Blood laked before pptn.
		Blood pptd. directly	Blood pptd. directly	
Rabbit— ½ g of STA orally. Blood taken after one hour.	3.0 (trip.)	3.5 (trip.)	..	
Man— 2 g of STA taken orally. Blood taken after two hours.	2.9 (dupl.)	3.6 (dupl.)	..	
Man— 1 g of STA taken orally. Blood taken after two hours.	2.8	3.3 (dupl.)	3.3 (dupl.)	
Rabbit— ½ g of STA taken orally. Sample after one hour.	3.5 (quad.)	4.0 (dupl.)	4.0 (dupl.)	
Man— 2 g of STA orally. Sam- ple after one hour.	2.3 (quad.)	2.6 (trip.)	2.6 (quad.)	
Man— 2 g STA orally. Sample after 4 hours.	2.7 (trip.)	3.1 (quad.)	3.1 (quad.)	

No interference from bubbles was noticed, because the sulfamate-nitrous acid reaction was eliminated. The time for a single analysis is reduced to about eight minutes. This is to be compared with about forty minutes for the Bratton and Marshall procedure, and about

twelve minutes for the Werner procedure.² Recovery of sulfathiazole added to whole blood was 95 to 100 per cent., at a dilution of 1:20, and results on blood of patients who have received the drug were about 15 per cent. higher by the micro method than by the Bratton and Marshall method. This was taken to indicate almost complete recovery of the drug. The color which was formed was stable enough to permit accurate analysis for twenty-four hours.

Substantiating experiments and a discussion of the results will be published elsewhere as soon as the method has been tested under clinical conditions.

The experimental procedure is briefly as follows: Whole blood (0.30 ml) is added dropwise with vigorous shaking to 5.70 ml of "acid mixture" which is prepared by adding 56 ml of 4 N sulfuric acid to one liter of 3.33 per cent. trichloracetic acid. The protein is allowed to coagulate and is filtered through Whatman number 1 or 42 paper. Sodium nitrite solution (0.10 per cent., 0.10 ml) is added to a 2.00 ml aliquot of the filtrate, and three minutes is allowed for diazotization. Ethyl alcohol (1.00 ml) is added, the tube swirled, and 0.10 ml of *N*-1 naphthyl ethylene diamine (0.10 per cent.) added. The color forms to its maximum intensity in fifteen seconds.

The determinations were carried out in flat-bottomed 10 ml vials, and the color intensities measured in micro cuvettes, using a Coleman Universal spectrophotometer. It was also noted that the values could be found with fair accuracy by visually comparing the developed colors with color standards made from a mixture of fuchsin and methyl violet.

S. W. LEE
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